European Commission

Joint Research Centre

Certified reference materials for the element content in metals and alloys

Trace elements in copper

	ERM-EB074 Electrolytic copper [mg/kg]	ERM-EB075 Electrolytic copper with added impurities [mg/kg]	BCR-017 [mg/kg]
Ag	1.03 ± 0.07	10.8 ± 0.6	
Al		2.3 ± 0.4	
As	1.23 ± 0.08	3.18 ± 0.10	
Au	0.52 ± 0.06	1.46 ± 0.14	
Be	0.31 ± 0.06	1.08 ± 0.24	
Bi	0.51 ± 0.04	1.79 ± 0.11	
Cd	0.40 ± 0.04	2.69 ± 0.09	
Co	0.83 ± 0.06	2.64 ± 0.08	
Cr	0.37 ± 0.04	1.40 ± 0.07	
Fe	5.8 ± 0.8	9.3 ± 0.4	
Hg	(< 0.1)	(< 0.35)	
In	0.49 ± 0.07	1.83 ± 0.10	
Mg	2.03 ± 0.27	7.0 ± 0.7	
Mn	0.93 ± 0.07	1.35 ± 0.07	
Ni	0.61 ± 0.08	2.18 ± 0.16	
P	1.53 ± 0.25	2.59 ± 0.30	6.85 ± 0.29
Pb	2.7 ± 0.4	4.8 ± 0.9	
S	(3.3 ± 1.0)	25 ± 4	10.4 ± 0.6
Sb	0.57 ± 0.04	2.93 ± 0.14	
Se	0.55 ± 0.07	1.69 ± 0.10	
Si		2.6 ± 0.4	
Sn	(1.5 ± 0.4)	2.13 ± 0.11	
Te	0.50 ± 0.06	1.78 ± 0.12	
Ti	0.97 ± 0.18	3.2 ± 0.5	
W	(< 0.25)	(< 0.1)	
Zn	2.2 ± 0.4	6.51 ± 0.29	
Zr	(8.8 ± 1.7)	(20 ± 5)	

Oxygen in copper

	BCR-022 Electrolytic tough pitch copper [mg/kg]	BCR-054R Low oxygen copper [mg/kg]	BCR-058 Continous cast copper [mg/kg]
O	138 ± 7	0.47 ± 0.07	390 ± 24

Values in brackets are not certified. CRMs are available as follows:

ERM-EB074A and ERM-EB075A: Disc of 39 mm diameter, 30 mm height, ERM-EB074B and ERM-EB075B: Cylinder of 8 mm diameter, 100 mm length, ERM-EB074C and ERM-EB075C: 50 g chips of approximately 250 mg, in amber glass bottle

BCR-017A: Disc of 42 mm diameter, 30 mm height, BCR-017B: 50 g chips in bottle, BCR-022A: Disc of 26 mm diameter, 9 mm height, BCR-022B: Cylinder of 9 mm diameter, 50 mm length, BCR-054R and BCR-058: Cylinder of 9 mm diameter, 50 mm length

BCR-691: Trace elements in copper alloys

	Quaternary bronze [g/kg]	Brass [g/kg]	Arsenic-Copper [g/kg]	Lead-bronze [g/kg]	Tin-bronze [g/kg]
As	1.94 ± 0.10	0.99 ± 0.10	46.0 ± 2.7	2.85 ± 0.22	1.94 ± 0.20
Pb	79 ± 7	3.9 ± 0.4	1.75 ± 0.14	92 ± 17	2.04 ± 0.18
Sn	71.6 ± 2.1	20.6 ± 0.7	2.02 ± 0.29	101 ± 8	70 ± 6
Zn	60.2 ± 2.2	148 ± 5	0.55 ± 0.05	1.48 ± 0.24	1.57 ± 0.25

Availability: Set of five discs (one of each composition) of 35 mm ∅ and 2 mm thickness, packed in a box.

Confidence in measurements

All certificates and detailed production information can be found at https://crm.irmm.jrc.ec.europa.eu

https://ec.europa.eu/jrc/

ERM European Reference Materials

BCR

Joint Research Centre

European Commission

Trace elements in unalloyed zinc

	BCR-321 [mg/kg]	ERM-EB322 [mg/kg]	ERM-EB323 [mg/kg]	ERM-EB324 [mg/kg]	ERM-EB325 [mg/kg]	BCR-326 [mg/kg]	BCR-327 [mg/kg]
Al	< 0.7						
Cd	(0.23 ± 0.03)	15.08 ± 0.30	6.51 ± 0.21	48.6 ± 1.1	94.7 ± 2.5	203.0 ± 2.0	301.4 ± 2.3
Cu	(0.97 ± 0.05)	5.89 ± 0.15	18.9 ± 0.4	9.87 ± 0.18	47.5 ± 2.0	104.8 ± 2.7	(0.56 ± 0.11)
Fe	(2.22 ± 0.14)	19.1 ± 0.8	11.3 ± 0.7	58.5 ± 1.6	56.1 ± 3.3	264.8 ± 2.1	144.0 ± 1.3
In	< 0.2						
Pb	4.85 ± 0.20	15.0 ± 0.5	48.6 ± 0.9	26.1 ± 0.5	142 ± 9	307.0 ± 1.6	409.4 ± 2.3
Sn	< 0.5	5.6 ± 0.6	18.7 ± 0.7	9.8 ± 0.5	46.1 ± 2.0		
Tl	0.78 ± 0.10	5.28 ± 0.30	10.8 ± 0.5	19.9 ± 0.5	36.8 ± 1.2		

Values in brackets are not certified.
Availability: Discs of 80 mm diameter and 20 mm thickness (BCR-321, -326, -327) and 60 mm diameter, 30 mm thickness, respectively (ERM-EB322, EB323, EB324 and EB325).

Elements in ZnAl4

	BCR-351 [mg/kg]	BCR-352 [mg/kg]	BCR-353 [mg/kg]	BCR-354 [mg/kg]	BCR-355 [mg/kg]
Al	[43.55 ± 0.11] x 10^3	[41.50 ± 0.10] x 10^3	[39.5 ± 0.4] x 10^3	[37.27 ± 0.16] x 10^3	[34.43 ± 0.13] x 10^3
Cd	(0.21 ± 0.03)	2.88 ± 0.12	10.44 ± 0.16	29.7 ± 0.4	58.1 ± 0.4
Cu	12.13 ± 0.15	31.26 ± 0.29	100.0 ± 0.8	312.3 ± 2.5	1035 ± 6
In	< 0.2	3.02 ± 0.28	2.55 ± 0.23	9.8 ± 0.9	24.6 ± 1.4
Mg	131.0 ± 0.9	283.0 ± 1.8	452.5 ± 2.4	602 ± 5	786 ± 6
Ni	(1.9 ± 0.6)	6.74 ± 0.16		83.1 ± 2.9	268 ± 8
Pb	4.50 ± 0.20	(6.4 ± 1.6)	24.4 ± 1.3	30.8 ± 1.2	56.9 ± 1.9
Sn	< 1	3.0 ± 0.7	5.6 ± 0.6	14.1 ± 1.1	29.1 ± 2.0
Tl	0.74 ± 0.06	3.2 ± 0.4	3.95 ± 0.22	11.01 ± 0.20	23.25 ± 0.28

Values in brackets are not certified.
Availability: Discs of 80 mm diameter and 20 mm thickness.

Elements in ZnAl4Cu1

	BCR-356 [mg/kg]	BCR-357 [mg/kg]	BCR-359 [mg/kg]	BCR-360 [mg/kg]	BCR-361 [mg/kg]
Al	[44.34 ± 0.11] x 10^3	[42.27 ± 0.11] x 10^3	[37.11 ± 0.11] x 10^3	[34.27 ± 0.12] x 10^3	[40.68 ± 0.19] x 10^3
Cd	0.73 ± 0.09	2.83 ± 0.10	29.8 ± 0.4	59.5 ± 0.6	(0.80 ± 0.17)
Cu	[3.944 ± 0.022] x 10^3	[5.849 ± 0.021] x 10^3	[9.89 ± 0.04] x 10^3	[12.34 ± 0.05] x 10^3	[7.98 ± 0.04] x 10^3
Fe	31.5 ± 0.6	25.7 ± 1.2	119.7 ± 1.1		10.34 ± 0.26
In	< 0.2	3.30 ± 0.14	15.5 ± 0.6	29.8 ± 0.6	(< 0.2)
Mg	132.3 ± 1.8	273 ± 4	557 ± 5	705 ± 5	
Ni	3.43 ± 0.19	9.82 ± 0.25	92.6 ± 0.6	267 ± 8	
Pb	9.87 ± 0.23	13.8 ± 0.6	36.2 ± 0.8	73.9 ± 1.4	5.31 ± 0.20
Sn	(0.32 ± 0.16)	3.51 ± 0.14	16.93 ± 0.22	33.0 ± 0.8	46.3 ± 0.9
Tl	0.79 ± 0.05	2.76 ± 0.05	13.34 ± 0.24	25.9 ± 0.7	37.4 ± 0.5

Values in brackets are not certified.
Availability: Discs of 80 mm diameter and 20 mm thickness.

Trace elements in lead

	BCR-286 Electrolytically refined lead [mg/kg]	BCR-287 Thermally refined lead [mg/kg]	BCR-288 Lead with added impurities [mg/kg]
Ag		15.20 ± 0.21	
As			55.7 ± 1.6
Bi	21.5 ± 0.5	67.3 ± 1.1	215.8 ± 2.4
Cd		0.356 ± 0.024	33.3 ± 0.9
Cu		0.98 ± 0.05	19.3 ± 0.4
Sb	0.099 ± 0.021	0.040 ± 0.015	
Se			< 0.2
Sn		< 0.05	32.8 ± 1.3
Tl	2.47 ± 0.07	0.73 ± 0.04	2.26 ± 0.08
Zn	< 0.1	< 0.1	8.2 ± 0.4

Availability: BCR-286A and -287A: blocks of 60 × 60 × 12 mm,
BCR-286B, -287B and -288B: chips in bottles containing about 160 g.

Joint Research Centre

European Commission

Elements in titanium and titanium alloys

	BCR-089 TiAl6V4 [mg/kg]	BCR-090 Titanium with added impurities [mg/kg]	BCR-024 Titanium [mg/kg]	BCR-059 TiAl6V4 [mg/kg]	BCR-318 Titanium [mg/kg]
Al	59700 ± 400				
C	38 ± 10				
B		28.2 ± 1.4			
Co		501 ± 14			
Cr	122 ± 6	533 ± 11			
Cu	10.3 ± 1.2	513 ± 9			
Fe	515 ± 16	563 ± 16			
H	31 ± 5				12.2 ± 0.6
Hf	0.126 ± 0.011				
Mn	4.2 ± 0.6	314 ± 10			
Mo	15.2 ± 1.8	488 ± 11			
N	212 ± 33		117 ± 13	172 ± 27	
Nb		(492 ± 26)			
Ni	106 ± 7	667 ± 7			
O	1660 ± 60		608 ± 23	1750 ± 70	
Sb	1.94 ± 0.12				
Sn	10.4 ± 1.7	(710 ± 50)			
Ta	0.30 ± 0.09				
V	39760 ± 290				
W	1.6 ± 0.4	(500 ± 40)			
Zr	2.8 ± 0.6	(436 ± 13)			

Values in brackets are not certified.
Availability: BCR-089: Cylinder of 40 mm diameter and 20 mm height. BCR-090A: Cylinder of 40 mm diameter and 20 mm height. BCR-090B: Cubes of about 0.2 g in bottles containing approximately 25 g. BCR-024B: 25 cubes of 0.4 g. BCR-024C: 25 cubes of 0.2 g. BCR-059A: Cylinder of 42 mm diameter and 30 mm height. BCR-059B: 25 cubes of 0.2 g. BCR-318: discs of 7 mm diameter and 1 mm height (+/- 100 discs in bottle)

Trace elements in Zircaloy-4

	BCR-098 [mg/kg]	BCR-275 [mg/kg]	BCR-276 [mg/kg]
C [mg/kg]		113 ± 4	108 ± 11
Cr [mg/kg]	906 ± 9		
Fe [mg/g]	2.143 ± 0.020		
H [mg/kg]			
Hf [mg/kg]	77.6 ± 3.0		
N [mg/kg]		39.0 ± 1.7	41 ± 9
O [mg/kg]		1670 ± 50	1540 ± 80
Sn [mg/g]	14.60 ± 0.09		

Availability: BCR-098: Bottles containing about 10 g of chips. BCR-275: discs of 13 mm diameter and 1 mm height (+/- 10 discs in bottle)
BCR-276: discs of 4.5 mm diameter and 2 mm height (+/- 100 discs in bottle)

How to order reference materials

From JRC in Geel

Tel.: +32 14 571 705 • Fax: +32 14 590 406 •
https://ec.europa.eu/jrc/en/reference-materials • E-mail: jrc-irmm-rm-distribution@ec.europa.eu

From authorised distributors

LGC Standards GmbH (DE)
http://www.lgcstandards.com/
E-mail: de@lgcstandards.com

Sigma-Aldrich Chemie GmbH (CH)
http://www.sigmaaldrich.com/irmm
E-mail: flukatec@sial.com

Sigma-Aldrich RTC Inc. (USA)
http://www.RT-Corp.com
E-mail: RTCSalesgroup@sial.com

ARMI (USA)
http://www.armi.com
E-mail: Info@ARMI.com

Joint Research Centre